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Physico-Chemical and Micro-Biological Characteristics of Sewage Waste Water in Khammam City, Telangana, India

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ABSTRACT

This study was conducted to findout the physico-chemical and microbiological parameters were analyzed in city waste water of Khammam city Telangana. This water has different pollution parameters i.e., Organic pollutants like dissolved oxygen, bio-chemical oxygen and chemical oxygen demand,Free carbon dioxide, organic matter, In-organic pollutants-electrical conductivity, turbidity, pH , total alkalinity, chloride, etc.,Temperature range from 23oC to 33oCThe minimum and maximum pH range from 6.4 to 7.4. The minimum and maximum total alkalinity range from 42 mg/L to 154 mg/L, The minimum and maximum chloride from 136.9 to 278.9 mg/Lwere found. Eutrophic factors like phosphates, nitrates, nitrites were analyzed. The microbiological parameters, total coliform bacteria, fungi, actinomycetes colonies were also analyzed.

Keywords: physical, Chemical, Microbial, Sewage waste water, Khammam

INTRODUCTION

The utilized water of the society is called sewage. This utilization may be domestic or industrial. Sewage may generally be caused by domestic waste and industrial waste. Domestic waste water is that which is discharged from residential and commercial establishments. The pollutants in domestic waste water arise from residential and commercial cleaning operations, laundry, food preparation, body cleaning functions and body excretions. The composition of domestic waste water is almost constant. Industrial waste water is discharged from manufacturing plants where water is used for various processes and also for washing and rinsing of equipment, laboratories, etc. The waste waters coming from industries create undesirable components before they are discharged into water bodies. If the treatment is not done, these wastes pollute water bodies and cause many problems.

Sewage water systems have complicated biological communities of microorganisms. Each degree of water pollution with organic substances corresponds to definite micro flora and micro fauna.

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Hence a possibility arises to establish the degree of pollution by the presence of indicator organisms in sewage canals.

The presence of such organisms indicates the quality of water or the quantity of microorganisms in the sewage systems. This can used to establish the degree of its pollution.

Due to scarcity of water, sewage water is being diverted into crop fields, vegetable crops, food crops etc. These are having heavy loads of organic substances, heavy metals, Organic chemicals and xenobioticin sewage is creating pools and mosquito breeding centers in the outskirts of the city causing a lot of damage to the environment. The entry of toxic pollutants through food chain is biomagnified and resulted in health hazards to human and animals.

In view of these facts about sewage we have undertaken an investigation to analyze and characterize the sewage waters flowing in different canals in and around Khammam city.

MATERIALS AND METHODS

Study Area:

Khammam city is historical city situated in-between the altitude of 17° 19' and 18°36' N and longitude of 78° 48' and 80° 43' E and populated around 8 lakhs do not have any good source of irrigation facility. Maximum temperature is up to 40° C, minimum temperature is 25° C in summer. The east west monsoon in rainy season the average rainfall is 870 mm.The common agricultural

crops paddy, maize, red gram, green gram and Capsicum etc. These crops are mainly depend for their irrigation on rain water and tanks, hence people are preferring to utilize the sewage waters for their crops without understanding damages to the environment and losses to their soil quality.

Methodology:

Sewage waste water samples were collected in day time, one time in a season selected sampling stations in three seasons [Rainy-August, Winter-December, Summer-April] waste water not available in May and Junemonths. The sewage water samples were collected in 9.00 a.m. to 4.00 pm. Four sewage water sampleswerecollected from various parts of the city i.e.

Station 1:sewage water collected from near Railway track.
Station 2: sewage water collected from near grain market.
Station 3: sewage water collected from near main highway.
Station 4: sewage water collected from fruit market.

Sewage water collected in clean 2 liters capacity plastic containersare taken to laboratory for analysis. All chemicals are analytical grade; chemicals were prepared with double distilled water. Physical characters such as temperature, color, odour and pH were analyzed on the spot. The remaining characteristics such as electrical conductivity, turbidity, and total dissolved solids were analyzed. The chemical characteristics are total alkalinity, free carbon dioxide , chlorides, dissolved oxygen (sewage and distilled water in 1:10), Chemical oxygen demand, biological oxygen demand and percentage of organic matter, nitrates, nitrites, ammonia and phosphates were analyzed as standard procedure suggested by APHA, AWAA, WPCF, (1998).

RESULTS AND DISCUSSION

The analysis of various physical characteristics of four sewage water samplesare present in table-1. It is clear that the color of the sewage water changed with season and station, it changed from brown to black with changed densities of sewage constituents. Generally the sewage water collected near Station 1 showed deep black color in majority of the months. The temperature is basically important for its effects on the chemistry and biological reactions in the organisms in water. The temperature variation was from 28o C to 33o C. The capacity of the substance or a solution to conduct an electrical flow is the conductivity. The electrical conductivity ranged from 0.032µmho to 0.168 µmho, during the present observation. The total dissolved solids were high in the month of December. In sewage water near Station 1 and the range varied from 2.50 mg/lit in all other sewage canals water under study. Turbidity in water is caused by the substances a particle size of less than 10-9.While the turbidity was 0.11 N.T.U to 0.35 N.T.U.in different sewage canals in different seasons. The odur of the sewage water has unacceptable majority of the months. Similar here studies Manian et al (1991), investigation the self-purification status of sewage water of Aligarh noted certain interesting and important physical attributes.

Table 1: Physical Characteristics Of Sewage Waste Water In Khammam City

S.No	CHARACTERISTICS	SEASON	STATION 1	STATION 2	STATION 3	STATION 4
1	Temperature ^{o}C	Rainy	23	23	24	25
		Winter	27	27	27	28
		Summer	31	32	33	33
2	Electrical conductivity (µmho)	Rainy	0.084	0.092	0.065	0.162
		Winter	0.56	0.113	0.168	0.152
		Summer	0.042	0.032	0.042	0.038
3	Total Dissolved Solids (mg/L)	Rainy	2	4	5	4
		Winter	3	6	8	9
		Summer	4	12	10	12
4	Turbidity (N.T.U)	Rainy	0.22	0.26	0.28	0.35
		Winter	0.11	0.16	0.14	0.28
		Summer	0.11	0.14	0.16	0.28

Temperature ^{0}C degree centigrade, N.T.U –Nephelo Turbidity Units
µmho- millimholes, mg/L-milli gram/Litre.

Station 1.Sewage canal at railway track; Station 2.Sewage canal at grain market.
Station 3.Sewage canal at main highway; Station 4.Sewage canal at fruit market.

Table-2: Chemical Characteristics Of Sewage Waste Water In Khammam City

S.No	Chemical Characteristics	Season	Station 1	Station 2	Station 3	Station 4
1	p^H	Rainy	6.8	7.1	6.4	7.2
		Winter	7.0	7.1	7.1	7.0
		Summer	6.8	7.0	7.4	6.7
2	Total Alkalinity(mg/L)	Rainy	69	73	65	42
		Winter	154	162	146	126
		Summer	56	70	86	98
3	Chloride(mg/L)	Rainy	136.9	135.4	144.2	278.9
		Winter	142.4	138.5	172.4	229.1
		Summer	180.2	145.2	206.9	145.4
4	Dissolved Oxygen(mg/L)	Rainy	9.1	7.6	9.4	9.6
		Winter	8.8	9.1	9.2	9.4
		Summer	7.7	7.5	8.8	7.9
5	Bio-Chemical oxygen demand(mg/L)	Rainy	2.2	2.4	2.8	5.6
		Winter	4.8	5.9	8.0	7.2
		Summer	6.8	4.4	6.6	7.2
6	Chemical oxygen Demand(mg/L)	Rainy	8.4	12.9	9.6	20.4
		Winter	15.9	16.8	17.2	20.2
		Summer	23.8	20.8	25.6	22.4
7	Free carbon dioxide(mg/L)	Rainy	2.86	3.52	2.42	7.48
		Winter	8.8	9.2	9.5	9.24
		Summer	6.4	7.22	8.28	9.9
8	Phosphate(mg/L)	Rainy	1.2	1.76	0.94	1.24
		Winter	1.05	1.35	1.08	2.61
		Summer	1.74	1.89	0.98	1.68
9	Nitrate(mg/L)	Rainy	0.42	0.61	0.47	1.12
		Winter	0.91	0.82	0.72	1.72
		Summer	1.25	1.31	1.71	1.84
10	Nitrite(mg/L)	Rainy	0.70	0.81	2.26	1.98
		Winter	1.9	2.52	2.9	1.98
		Summer	2.65	2.42	2.89	3.21
11	Ammonia (mg/L)	Rainy	0.80	0.98	1.32	1.89
		Winter	1.59	1.38	1.52	1.71
		Summer	1.74	1.92	2.08	2.22
12	Organic matter %	Rainy	0.208	0.206	0.218	0.272
		Winter	0.202	0.284	0.248	0.189
		Summer	0.178	0.202	0.228	0.198

Station 1.Sewage canal at railway track.;Station 2.Sewage canal at grain market.
Station 3.Sewage canal at main highway.;Station 4.Sewage canal at fruit market.

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The chemical characteristics of the sewage water were analyzed and presented in table-2. pH is the measure of the intensity of acidity or alkalinity and measure the concentration of hydrogen ions in water , No significance fluctuations were recorded in the pHlevels which varied from 6.4 to 7.4.The alkalinity of many surface water is primarily a function of carbonates, bicarbonates phosphates, silicates and other bases. Which reveals that total alkalinity fluctuated from 42 mg/L at station-4 in rainy season to 162 mg/L at station-2 in winter season the highest alkalinity content was recorded in December in sewage canal near Station 4. Chloride ion is one of the major inorganic anions in water and waste water. Its pressure in large amounts in regulated as pollution. The highest chloride levels varied between 136.9 mg/L at station-4 in rainy season to 278.9 mg/L at station-1 in rainy season. In sewage canals in station. Dissolved oxygen is one of the important and critical characteristics in water quality assignment. Its presence is essential to maintain the higher form of biological life and to keep the proper balance of various populations and thus water body healthy. The analysis of dissolved oxygen which is a key in water pollution and waste treatment process showed its highest content 9.6 mg/L at station-2 in rainy season in August. In the sewage canal near Station-4 and least

Table 3: microbiological characteristics of sewage waste water in khammam city

Sl.No	CHARACTERISTICS	SEASON	STATION 1	STATION 2	STATION 3	STATION 4
1	General coliform bacteria ($1X10^6$)	Rainy	28	45	26	85
		Winter	88	51	108	121
		Summer	89	101	94	76
2	Fungi ($1X10^5$)	Rainy	28	39	16	22
		Winter	44	41	52	48
		Summer	24	30	36	40
3	Actinomycetes ($1X10^5$)	Rainy	38	99	86	42
		Winter	84	45	68	49
		Summer	54	70	38	60

Station 1. Sewage canal at railway track ; Station 2. Sewage canal at grain market
Station 3.Sewage canal at main highway ; Station 4. Sewage canal at fruit market

content 7.6 mg/L in rainy season was noted in August in sewage canal near Station-1. The determinant of relative oxygen requirements of waste water, effluents and polluted water. The biological oxygen demand is an empirical test to determine the relative oxygen requirements of waste water and effluents .Thus measures the required for bio chemical degradation of organic material and oxygen use to oxidize organic materials. In the biological oxygen demand was analyzed and showed its variations from 12 mg/L sewage canal near Station-3 in August to 182 mg/L (sewage canal near Station-3 in April) the oxygen equivalent of organic matter content of samples that is susceptible to oxidation by a strong chemical oxidant. Chemical oxygen demand is the oxygen equivalent of the organic matter content of sample that is susceptible to oxidation by a strong chemical oxidant. Chemically oxidisable organic sub states of different water enter into aquatic system are responsible for changing chemical oxygen demand levels. Chemical oxygen demand has showed its range of variation from 2.8 mg/L – 112.0 mg/L the organic matter composed of a variety of organic compounds of various oxidation states showed it fluctuations from 0.01 to 0.253 % specifically with station differentiation. Large amount free carbon dioxide was recorded in the month of April. 2.42 mg/L and in the remaining months the free carbon dioxide range was moderate, which was between 9.5 mg/L. The Percentage of organic matter composed of a variety of organic compounds of various oxidation states was showed its fluctuations from 0.012% - 0.253% specifically with site differentiation. Von Sperling et al (2002), Wasay and Jain (1988), Tripati et al (1991) and Selvan et al (1994) also said the city sewage discharged in to nearby aquatic bodies causea lot of disturbances and imbalances in the ecosystems. Singh et al (1991) analyzed the city sewage drains entering Ganga at Patna and noted the highest loads of physical and chemical pollutants. Saksera and Mishra (1991) developed a novel water quality index and self-purification capacity of sewage collecting channel at Gwalior. Sewage has large quantities of nitrogenous matter, Thus its disposal tends to increase the ammonia content of the waters (Berrow and Webber 1972).The ammonia regulant of various microbial activities showed its broad range with seasonal changes, which varied from 0.80 mg/L to 2.22 mg/L . Generally the ammonia content was high in the sewage water near Station-4. The nitrate and nitrite, related compounds of ammonia were shown in a peculiar presence in the present observation. Nitrate which showed its highest content 1.84mg/ml. In sewage canal flowing adjacent to Station-4 showed the absence of nitrate except in April.

Microorganisms constitute an invaluable component of an ecosystem. This is a natural resource of immense value. Isolation, identification and maintenance these of microbial wealth are considered essential to understand the ever increasing problems of humans and also to find suitable cost effective solutions to them. A recent estimate of microbial diversity indicated that only 1% of naturally occurring microorganisms are known, while the rest remains undiscovered. The microbiological examination of sewage water samples were made to determine their secretory microorganisms' the determined enumeration quantity of different microorganisms are reported in Table-3. The minimum coliform bacteria colonies were 26x106 at station-3 in

winter season. The maximum coliform bacteria colonies were 121x106 at station-4 in rainy season. The standard association between fungal densities and organic loading suggested that fungi are better bioindicators of pollution. The common fungal colonies were observed in four sewage canals are as fallows Aspergillusniger, A. flavus, A. fumigatus and Pencillium, Nigraspora, Rhizopus,Mucor, Memnotlla and Fusararium. The numbers of population of actinomycities were observed. An extensive impact on environment by decomposing and transforming a wild variety of complex organic residues they constitute the proportion of population in sewage canals which ranged from 16x106 at station-3 in rainy season to 52x106at station-3 in winter season between 84x105. Chitra and Vittal (1989) and Khulbe and Durgapal (1994) estimated the densities of fungal and bacterial population with raw and treated sewage in various oxidation ponds and lagoons. Goutham et al (1989) studied different sewage canals signified their role in managing and maintaining the microbial population. Chona (1990) also prepared a status report on the variation in microbial quality of sewage at Chandigarh.

Conflict of Interests

Authors declare that there is no conflict of interests regarding the publication of this paper.

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